mitochondria in that they are larger and rounded, while the mitochondria are very small granular or rod forms. Cells from the thallus of *Anthoceros* were studied because they have each a single chloroplast and hence furnish favorable objects for determining whether mitochondria are merely disorganized chloroplasts. This question is answered in the negative. In *Adiantum pedatum* he finds that the mitochondria are small, granular, and rod-shaped. Discussion is here confined to root tips, and we are promised a subsequent paper dealing with other parts. The "plastid primordia" are rounded, lenticular, and rod-shaped, but much larger than the mitochondria. The rod-shaped "primordia" which do not develop into leucoplasts "continue to elongate into long-drawn-out threads and finally disappear." In the younger growing parts of the stem of *Pinus Banksiana* numerous small rounded bodies with colorless centers (plastid primordia) and densely staining granules (mitochondria) were found. In the older parts these bodies with the colorless centers form the plastids, while the granular mitochondria have become larger or formed rod mitochondria. In the leaves of *Elodea canadensis* the primordia are rod-shaped and can easily be traced in their transformation into plastids. The mitochondria are very numerous, and in cells with fully developed chloroplasts they are globular and even rod-shaped, differing from the primordia only in size. We are promised a later paper dealing with his results on *Hydrodictyon*.

GUILLIERMOND includes under the term mitochondria all those structures which give the same histochemical reactions, regardless of their functions; while MOTTIER, on the other hand, considers only those structures which do not develop into plastids to be included under the term. Both, however, agree that these structures are "morphological units of the cell with the same rank as the nucleus." MOTTIER goes farther and asks, "What characteristics are transmitted solely by the nucleus, and what by the primordia of plastids and by the chondriosomes? There are many transmissible characteristics which cannot as yet be definitely expressed in any Mendelian ratio. To claim that certain phenomena of fluctuating variations and other numerous characteristics, Mendelian or otherwise, owe their appearance and transmission to the primordia of plastids and chondriosomes may be a daring hypothesis, but if, as there is good ground to believe, these bodies are permanent organs, there is no escape from some such assumption."—RAY C. FRIESNER.

Units of vegetation and their classification.—With the advance of the science of ecology there has been a gradual evolution of opinion as to the units most suitable for the analysis and study of vegetation. The earlier stages of this evolution have been well discussed by MOSS,[7] who also advanced the developmental concept of the plant formation. The half decade following this paper passed without a further notable contribution to the subject, but recently three

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[7] MOSS, C. E., The fundamental units of vegetation. New Phytol. 9:18–53. 1910.

articles have appeared that are notable, not only for the divergence of the views expressed, but also for the decided advance they have made in providing a logical system of classified units for the use of students of vegetation.

GLEASON[8] embodies in his article an individualistic concept of ecology, contending that all phenomena of vegetation depend upon the phenomena of the individual plant. The plant association he conceives to be an area of uniform vegetation developed by similar environmental selection from the immigrants from the surrounding population. This position, while extreme, will prove most useful if it serves to focus attention upon the intensive study of some of the most important species of a vegetation so as to discover their reactions to various environments and to the factors which limit their invasion and establishment in plant communities.

The other extreme is seen in the work of CLEMENTS,[9] as expressed in what doubtless is the most notable of recent contributions to ecological literature. Without attempting to review or criticize his book as a whole, it may be pointed out that he selects the formation as the fundamental unit and regards this plant community as an organic entity exhibiting origin, growth, maturity, and death. As an organism it is able to reproduce itself and possesses a life history which is a complex but definite process. The climax community is the adult organism of which all initial and medial stages are but stages of development. Thus CLEMENTS would limit the term formation to the climax community, while the successional series leading up to the climax formation he calls a "sere." He has provided a complete system of subordinate units for the analysis of both formation and the sere, the former being divided successively into associations, consociations, societies, and clans; the latter into associes, consocies, socies, colonies, and families. This recognition of a plant community as an entity comparable in some extent at least to an organism seems strictly in accord with the views of most ecological workers, and if the relationship be regarded as one of close analogy rather than homology it will probably prove the most stimulating and satisfactory attitude. It appears, however, that CLEMENTS' system of subordinate units is rather more elaborate than is required to meet the needs of most investigators.

A somewhat simpler system, introducing but few new concepts or terms, recently organized by NICHOLS,[10] commends itself to the reviewer as including those units and terms which in the past have proved most satisfactory, and which now for the first time have been combined in a definite system. NICHOLS

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[8] GLEASON, H. A., The structure and development of the plant association. Bull. Torr. Bot. Club 44:463–481. 1917.

[9] CLEMENTS, F. E., Plant succession. Carn. Inst. Wash. Pub. 242. pp. xiii+511. *pls. 61.* 1916.

[10] NICHOLS, GEO. E., The interpretation and application of certain terms and concepts in the ecological classification of plant communities. Plant World 20:305–319, 341–353. 1917.

himself claims that the scheme is the outgrowth of the classification originally presented by COWLES,[11] and by his selection of the association as the fundamental unit of vegetation he recognizes the tendency of ecologists as a whole to become more and more agreed upon the use of the term "plant association," even while differing somewhat as to the content of the term. He defines the association as any community of plants, taken in its entirety, which occupies a common habitat, or in other terms, any stage in a given successional series. The "habitat," thus made the criterion of the association, is understood to be a unit area with an essentially uniform environment made up of a complex of climatic, edaphic, and biotic factors which determine the ecological aspect of the vegetation. The subdivisions of the association agree with those of CLEMENTS in being consociation and society, but differ in that "association" (and its subdivisions) is applied to both the climax and the seral units.

Here NICHOLS has added a most useful although rather abstract concept of "association type," defined as "a type of plant association which is correlated with a given type of habitat." The association type which represents the highest degree of mesophytism which the climate of the region permits is regarded as the regional climax. It has been usual to regard as permanent only such associations as are included in such a regional climax type, but NICHOLS holds that in edaphically unfavorable situations not only is succession much slowed down, but that it often becomes permanently arrested at a point far short of the climax just mentioned. In this way there would be developed permanent associations less mesophytic than the regional climax association type. These may be distinguished as belonging to an "edaphic climax." Most ecologists recognizing this situation have preferred to regard such associations as belonging to a "temporary climax," postulating the eventual although much delayed dominance of a climax limited by climate only.

Grouping plant associations upon a developmental basis, the plant community of the next higher order is termed an "edaphic formation" and defined as "an association-complex which is related to a specific physiographic unit area." Here the "formation" differs from that of CLEMENTS in including not only the climax community but also those of seral rank. Edaphic formations are in turn grouped into "edaphic formation-types" and the "edaphic formation-complex" for any climatic region constitutes a "climatic formation." In this use of the terms edaphic formation and climatic formation NICHOLS has retained the well known classification of SCHIMPER, while modifying the concepts to include the developmental idea. The various climatic formations belong to various "climatic formation-types," several of which may form the "climatic formation-complex" of a continent or other large unit area.

NICHOLS has further demonstrated the utility of his excellent scheme of classification by applying it to the analysis of the vegetation of northern Cape

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[11] COWLES, H. C., The physiographic ecology of Chicago and vicinity. BOT. GAZ. 31:73–108, 145–235. 1901.

Breton Island, appending various explanatory remarks which should prove useful to students attempting to make similar applications to other regions.—GEO. D. FULLER.

Permeability.—Several interesting contributions to our knowledge of protoplasmic permeability have appeared recently. DELF[12] has investigated the influence of temperature on the permeability of protoplasm to water by the tissue shrinkage method, using sections of onion leaves and dandelion scapes in subtonic solutions of cane sugar. The curve of contraction at different temperatures was measured by means of an optical lever which greatly magnified the shrinkage, and from this curve the rate of contraction at the time when 30, 50, and 70 per cent of the shrinkage had occurred, was measured by the tangents to the curves at these points. From the rates the values for Q_{10} were obtained. This value increases as the temperature rises. In the onion leaf the value of Q^{10} at 10–20° C. is 1.5, at 20–30° C. is 2.6, and at 30–40° C. is 3.0. In the dandelion scape the greatest value of Q_{10} was obtained at 20–30° C., at which temperatures it was 3.8. Above and below those temperatures the value falls. Contrary to the results of VAN RYSSELBERGHE, who found very little increase in permeability above 20° C., DELF finds that permeability of the protoplasm to water continues to increase rapidly up to the highest temperature investigated, 42° C. The methods used by VAN RYSSELBERGHE are justly criticized, particularly with reference to the means of deriving a temperature relation from his data. The strength of solutions used by VAN RYSSELBERGHE may also have led to serious errors.

Miss HIND[13] has studied the absorption of acids by living plant tissues, using electrical conductivity methods, and electrometrical measurement of the H^+ ion concentration in acid solutions which were in contact with living potato disks and roots of *Vicia Faba*. She found that the hydrogen ion is rapidly absorbed from dilute acid solutions by living tissues, and concluded that the anion, particularly in organic acids, plays a large part in determining the effects of the acid on protoplasm. In the case of the mineral acids, HCl, HNO_3, and H_2SO_4, the stronger solutions can penetrate the cells for a time without causing much injury as measured by exudation of electrolytes; but organic acids like formic and acetic cause very rapid increase in conductivity, due to exosmosis of electrolytes from the cell. With these two acids there is first a decrease and then after a few hours a very noticeable increase in H^+ ion concentration. This is thought to be due possibly to the production of acids within the tissues which diffuse out through the altered plasmatic membrane.

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[12] DELF, E. MARION, Studies of protoplasmic permeability by measurement of rate of shrinkage of turgid tissues. I. The influence of temperature on the permeability of protoplasm to water. Ann. Botany **30**:283–310. 1916.

[13] HIND, MILDRED, Studies in permeability. III. The absorption of acids by plant tissue. Ann. Botany **30**:223–238. 1916.